Biocompatibility of Ultrananocrystalline Diamond (UNCD) Thin Films

Scientific Achievement

This is a new research program funded by a 2006 LDRD competitive grant. The research is at the very initial stage. In the past weeks, preliminary research has been done. UNCD diamond films have been developed. SEM (Figure 1) and Raman methods have been used to analyze the developed UNCD thin films. The Si substrate was etched off and self-supported UNCD films were obtained (Figure 1 and 2). Cell culture was performed on the UNCD. The cells are mouse embryonic fibroblast (MEF). The cells were cultured for 36 hours in the incubator. The cell growth on UNCD thin film reached the same confluency as the culture dish (Figure 3). Cell culture dishes are pretreated with γ-irradiation, chemically, or with an electric ion discharge to produce a charged surface that is wettable for cell growth. UNCD is hydrophobic. The same cell growth and confluency rates on two different culture vessels showed that this kind of UNCD that has been tested provided the same environment for cell growth and could host the cell responses. The mechanisms of the cell growth need to be further studied since it is still not understood that if it is the UNCD film or it is the protein secreted by the cells that are responsible for the cellular responses.

Significance

This study will have high social impact on biosensors and implantable medical devices. Artificial three-dimensional (3D) scaffolds store or attract cells, and then direct cell proliferation and differentiation. These are very important for regenerative medicine such as prosthetic implants. Most previous work showed that porous cell-seeded artificial scaffolds are biodegradable, such as bioinert polymers. In this study we plan to study the solid scaffold UNCD thin films as the artificial 3D scaffolds from both the bioactive and bioinert point of views. Preliminary study showed that cells could be regenerated on UNCD. The interactions between the extracellular matrix (ECM) and UNCD will be investigated, as well as the cell-signalling molecules as a source of molecular regeneration messengers. This study will involve nanoscale engineering of materials surfaces.

Performers

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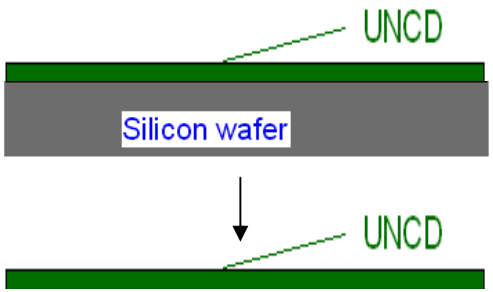

Figure 1. Etch Si substrate to produce free-standing UNCD film

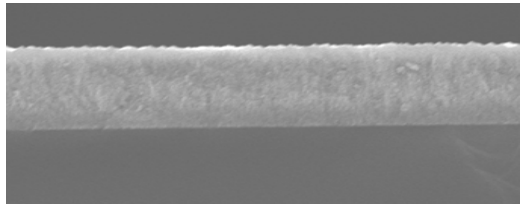

Figure 2. UNCD (cross-section SEM image)

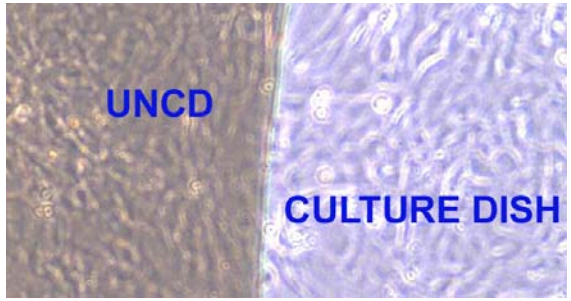

Figure 3. Mouse embryonic fibroblast cells growth on UNCD reached the same confluency as the culture dish.

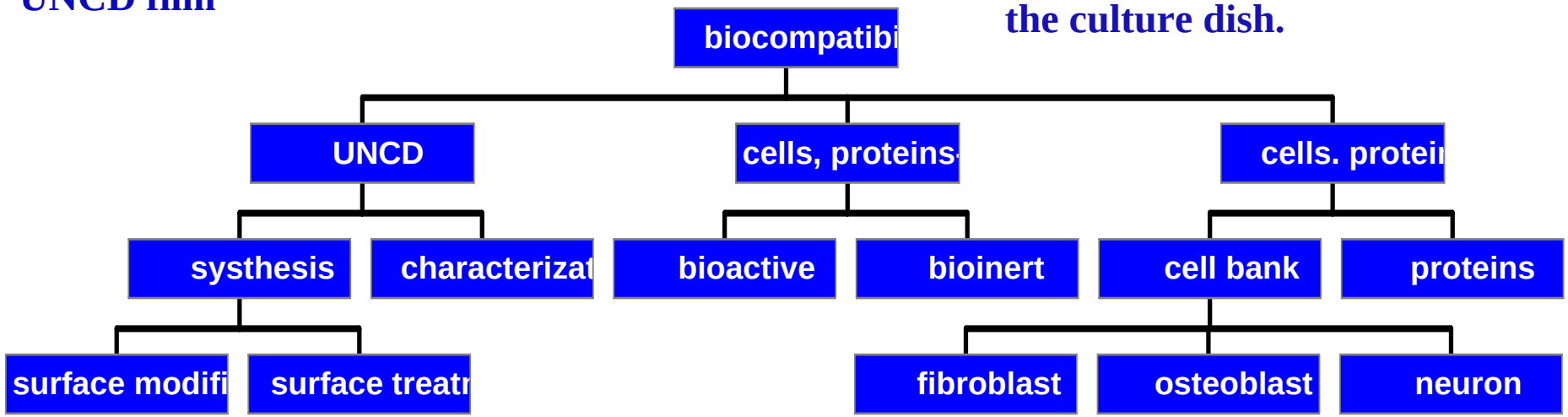

Figure 4. Future work

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